Microbial Populations in Spacecraft Assembly Facilities as Determined by LAL Assay.
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Clean room facilities must maintain environments that are as free from microbial contamination as possible in order to meet strict cleanliness requirements of sensitive flight hardware during assembly. In order to meet rigid schedules, a more rapid, sensitive assay is required to replace the current time-consuming conventional microbial assay. A commercially available, FDA-approved, rapid microbial detection method, Limulus Amebocyte Lysate (LAL) assay, was chosen to measure the microbial contamination of various Jet Propulsion Laboratory facilities. The LAL assay detects the endotoxins (organic molecules) such as lipopolysaccharide, glucan, peptidoglycans, etc., originating from viable and dead microbial cells (total microbial burden). Although various approaches exist to quantify and equate the endotoxin unit to the number of microbial cells, we assume in this study that one picogram of endotoxin unit is equivalent to one cell. Approximately 200 samples were taken from various classes of clean rooms (class 10 to 100,000 particles/ft^3) at different locations and analyzed for total microbial burden by LAL assay and total aerobic population by conventional microbial assay in Trypticase Soy Agar (cultivable counts). Unclassified areas such as entrance floors, shoe cleaners, air-showers, and ante-rooms of the sampled facilities were contaminated to 10^2 to 10^3 pg/in^2 endotoxin levels, whereas, most of the classified clean room facilities were contaminated to undetectable levels. Total microbial burden was observed to be either equivalent or only one-log more (for shoe-cleaner areas) than measured by cultivable counts. The over-all low microbial burden seen in this study might be due to the fact that the LAL assay is limited to the detection of bacteria that are capable of producing endotoxins only, while we were able to isolate more Gram-positive bacteria by cultivable counts. The combination of the conventional microbial assay, which is laborious and time-consuming (~72 h) and the rapid LAL assay (~1 h) is necessary to assess the total gross microbial contamination.